# Chemical Equilibrium - 2

**1. The gaseous reaction A + B $\rightleftharpoons$ C + D + heat has reached equilibrium. It is possible to make the reaction to proceed forward**

1) By adding more of C

2) By adding more of D

3) By raising the temperature of the system

4) By lowering the temperature

**Hint:** $\because$ it is an exothermic reaction.

**2. Given the reaction 2X (g) + 2Y (g) $\rightleftharpoons$ Z (g) + 80 k.cals, which combination of pressure and temperature gives the highest yield of Z at equilibrium**

1) 1000 atm and $500^0$ C    2) 500 atm and $500^0$ C

3) 1000 atm and $100^0$C    4) 500 atm and $100^0$ C

Hint: Forward reaction is favored by Low temperature $\because$ it is an exothermic reaction and High 'P' as no. of moles decreases.

**3. In which of the equilibrium, the position of the equilibrium shifts towards products, if the total pressure is increased**

A) $N_2$ (g) + $3H_2$ (g) $\rightleftharpoons$ $2NH_3$ (g)

B) $I_2(g) + H_2(g) \Leftrightarrow 2HI(g)$

C) $N_2$ (g) + $O_2$ (g) $\rightleftharpoons$ 2NO (g)

D) $N_2O_4$ (g) $\rightleftharpoons$ $2NO_2$ (g)

1) B    2) C    3) A    4) D

**Hint:** Increase of pressure shifts the reaction in the direction of decrease in moles.

**4. The degree of dissociation of $PCl_5$**

1) Increases with increasing pressure

2) Decreases with increasing pressure

3) No effect on change in pressure

4) Decreases with decreasing pressure

**Hint:** Dissociation of $PCl_5$ involves increase of moles

**5. In which of the following systems, doubling the volume of the container causes a shift to right?**

1) $H_2 (g) + I_2 (g) \rightleftharpoons 2HI (g)$

2) $2CO (g) + O_2 (g) \rightleftharpoons 2CO_2 (g)$

3) $N_2 (g) + 3H_2 (g) \rightleftharpoons 2NH_3 (g)$

4) $PCl_5 (g) \rightleftharpoons PCl_3 (g) + Cl_2 (g)$

**6. In the dissociation of $CaCO_3$ in a closed vessel, the forward reaction is favoured by**

1) Adding of more $CaCO_3$

2) Removal of some CaO

3) Increasing the pressure

4) Decreasing the pressure by removing some $CO_2$ from the equilibrium mixture

**Hint:** Removal of product favours the forward reaction.Addition and removal of a solid has no effect.

**7. In the reaction $NH_4HS(s) \rightleftharpoons NH_3 (g) + H_2S (g)$ on doubling the concentration of ammonia the equilibrium concentration of $H_2S$**

1) Is reduced to half its initial value 2) Increases by two times

3) Remains unchanged 4) Increases by four times

**Hint:** Increase of products concentration favours the backward reaction

**8. In a gaseous reaction 2A $\rightleftharpoons$ 3B on doubling the volume of container the equilibrium amount of the product**

1) Increases 2) Decreases 3) Remains same 4) Data Insufficient

**Hint:** Doubling the volume of container, Pressure decreases. Decrease of pressure shifts the reaction in the direction of increase in moles.

**9. Manufacture of ammonia by Haber's process involves the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ = -22.4 k cals. The effect of increase of temperature on the equilibrium is**

1) Equilibrium is shifted to the right

2) Equilibrium is unaffected

3) Equilibrium is shifted to the left

4) Equilibrium is shifted first to right then to left

**Hint:** Increase of pressure shifts the reaction in the direction of decrease in moles.

**10. Backward reaction is favoured by increase in the pressure of the equilibrium**

1) $2SO_2 + O_2 \rightleftharpoons 2SO_3$ 2) $N_2 + O_2 \rightleftharpoons 2NO$

3) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ 4) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

**Hint:** Increase of pressure shifts the reaction in the direction of decrease in moles.

**11. In the manufacture of $NH_3$, which are favourable conditions?**

1) High pressure and low temperature

2) High pressure and high temperature

3) Low pressure and low temperature

4) Low pressure and high temperature

**Hint:** $N_2 + 3H_2 \rightleftharpoons 2NH_3$ $\Delta H$=-92Kj/mole .Forward reaction is exothermic and involve decrease of moles.

**12. In which of the following equilibrium reaction the equilibrium would shift to the right, if pressure is increased**

1) $2SO_2 + O_2 \rightleftharpoons 2SO_3$ 2) $H_2 + I_2 \rightleftharpoons 2HI$

3) $H_2 + Cl_2 \rightleftharpoons 2HCl$ 4) $N_2O_4 \rightleftharpoons 2NO_2$

**Hint:** Ans; 1. ∵No. of moles decreases in forward reactin.

**13. The equilibrium concentration of $C_2H_4$ in the following reaction can be increased by $C_2H_4$ (g) + $H_2$ (g) $\rightleftharpoons$ $C_2H_6$ (g); ΔH=- 31.7 K.Cal**

1) Removal of $C_2H_6$ 2) Addition of $H_2$

3) Increase in temperature 4) Increase in pressure

**14. Ammonium chloride dissolves in water with the absorption of heat. Which of the following is true?**

1. The solubility of ammonium chloride decreases with increase in temperature
2. The solubility of ammonium chloride increases with increase in temperature
3. At higher temperature, ammonium chloride in solution exists as ammonia and Hydrochloric acid
4. At lower temperature ammonium chloride in solution is present in the molecular form

**Hint:** As dissolution is endothermic, high temperature favours solubility.

**15. For the reaction $H_2$ (g) + $I_2$ (g) $\rightleftharpoons$ 2HI (g) at 721K, the value of equilibrium constant is 50. The value of $K_p$ under the same conditions will be**

1) 0.02 2) 0.2 3) 50 4) 50/RT

Hint; $K_P = K_C$ as $\Delta n=0$.

**16. The effect of increasing the pressure on the following gaseous equilibrium 2A + 3B $\rightleftharpoons$ 3C + 2D is**

1) Favours forward reaction 2) Favours backward reaction

3) No effect 4) Favours for forward and backward reaction

**17. Cosider the reactions**

. i) $PCI_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$, ii) $N_2O_4(g) \Leftrightarrow 2NO_2(g)$

The addition of an inert gas at constant volume:

1). Will increase the dissociation of as well as

2). Will reduce the dissociation of as well as

3). Will increase the dissociation of and step up the formation of

4). Will not distrub the equilibrium of the reactions

Hint: At constant volume addition of inert gas not disturb equilibrium state.

**18. In a reaction $A_2$ (g) + $4B_2$ (g) $\rightleftharpoons$ $2AB_4$ (g); $\Delta H<0$, the formation of $AB_4$ (g) will be favoured at**

1) Low temperature and high pressure

2) High temperatue and low pressure

3) Low temperature and low pressure

4) High temperature and high pressure

**19. In the equilibrium $4H_2O$ (g) + 3Fe(s) $\rightleftharpoons$ $Fe_3O_4$(s) + $4H_2$ (g) the yield of $H_2$ can be increased by**

1) Increasing the pressure

2) Passing more steam

3) Increasing the mass of iron

4) Decreasing the pressure

**20. LeChatelier's principle is applicable to**

1) Chemical equilibria only

2) Physical equilibria only

3) Both 1 & 2

4) Neither 1 nor 2

**21. The molar concentrations of A, B and C at equilibrium for the reaction A + 2B $\rightleftharpoons$ 3C are 2, 3 and 4 moles/ lit respectively. Its $K_c$ is**

1) 2 2) 3.56 3) 0.2 4) 0.026

**Solution:** $K_C = \frac{[C]^3}{[A][B]^2}$

22. **The equilibrium constant $K_c$ of a reversible reaction is 10. The rate constant for the reverse reaction is 2.8. What is the rate constant for the forward reaction?**

1) 0.28 2) 28 3) 0.028 4) 280

**Solution:** $K_C = K_f/K_b$

23. **The equilibrium constants for the reactions**

**$N_2$ (g) + $O_2$ (g) $\rightleftharpoons$ 2NO (g) and**

**NO (g) + 1/2 $O_2$ (g) $\rightleftharpoons$ $NO_2$ (g) are $K_1$ and $K_2$ respectively. Then the equilibrium constant for the reaction $N_2$ (g) + $2O_2$ (g) $\rightleftharpoons$ $2NO_2$ (g) is**

1) $K_1/K_2$ 2) $K_1^2 - K_2^2$ 3) $K_1 K_2^2$ 4) $K_{1/} K_2^2$

**Solution;** Multiply the second equation with (2) and then add both.

24. **For the reaction C(s) + $CO_2$ (g) $\rightleftharpoons$ 2CO (g), the partial pressures of $CO_2$ and CO are 4.0 and 4.0 respectively at equilibrium, what is the value of $K_p$ for this reaction**

1) 0.5 2) 1.0 3) 4.0 4) 32

**Solution:** $K_P = \frac{P_{co}^2}{P_{CO_2}}$

25. **The $K_c$ for the reaction A + B $\rightleftharpoons$ C is 4 and $K_c$ for 2A+D $\rightleftharpoons$ C is 6 the value of**

**$K_c$ for C+D $\rightleftharpoons$ 2B is**

1) 0.67 2) 0.375 3) 2.7 4) 1.5

**Solution;** Equation2- 2X Equation1. i.e. $K_C = K_2/K_1^2 = 6/4^2 = 6/16 = 0.375$

26. **The equilibrium constant for the reaction**

**$H_2$ (g) + $I_2$ (g) $\rightleftharpoons$ 2HI (g) is 81 at a certain temperature. If the concentrations of $H_2$ and $I_2$ are 3 mole / lit each at equilibrium, the equilibrium concentration of HI is**

1) 3 mole / lit		2) 27 mole / lit

3) 9 mole / lit		4) 13.5 mole / lit

Solution; $K_C = [HI]^2/[H_2][I_2]$

**27. 4.5 moles each of hydrogen and iodine are heated in a sealed 10 litre vessel. At equilibrium 3 moles of hydrogen iodide was found. The equilibrium constant for $H_2$ (g) + $I_2$ (g) $\rightleftharpoons$ 2HI (g) is**

1) 1		2) 10		3) 5		4) 0.33

**Solution**

$$H_2 + I_2 \Leftrightarrow 2HI$$

| | | | |
|---|---|---|---|
| Initial | 4.5 | 4.5 | O |
| Reacted & formed | 1.5 | 1.5 | 3.0 |
| At equilibrium | 3/10 | 3/10 | 3/10 |

$K_C=[HI]^2/[H_2][I_2]$ =(3/10)x(3/10)/(3/10)=1

**28. 4 moles of HI is taken in a lit closed vessel and heated to equilibrium. At equilibrium, the concentration of $H_2$ is 1 mol lit$^{-1}$. The equilibrium constant is**

1) 4		2) 0.5		3) 2		4) 0.25

**Solution:** $2HI \Leftrightarrow H_2 + I_2$

Initial: 4 0 0

**At equilibrium**: 4-2x x x But given at equilibrium concentration of $H_2$ is 1 mol lit$^{-1}$ i.e. X=1 $K_C = [H_2][I_2]/[HI]^2$ =1X1 /$2^2$ =1/4=0.25

**29. 9.2 gm of $N_2O_4$ (g) is taken in a closed one litre vessel and heated till the following equilibrium is reached $N_2O_4$ (g) $\rightleftharpoons$ $2NO_2$ (g). At equilibrium 50% of $N_2O_4$ (g) is dissociated. What is the equilibrium constant (in mole lit$^{-1}$) (M.wt. of $N_2O_4$ is 92)**

1) 0.1		2) 0.2		3) 0.4		4) 2

Solution: moles of $N_2O_4$=9.2/92= 0.1

$N_2O_4 (g) \rightleftharpoons 2NO_2$ (g

| | $N_2O_4$ | $NO_2$ |
|---|---|---|
| **Initial** | 0.1 | 0 |
| Reacted & Formed | 0.05 | 0.1 |
| At equilibrium: | 0.05 | 0.1 |

$K_{C=}$ $[NO_2]^2 / [N_2O_4] = [0.1]^2 / [0.05] = 0.2$

**30. 1 mole of A (g) is heated to $300^0$ C in closed one litre vessel till the following equilibrium is reached A (g) $\rightleftharpoons$ B (g) The equilibrium constant for the reaction at $300^0$C is 4. What is the concentration of B (in mol. $lit^{-1}$) at equilibrium?**

1) 0.2 2) 0.6 3) 0.8 4) 0.1

**Solution:** A (g) $\rightleftharpoons$ B (g)

| | A | B |
|---|---|---|
| Initial | 1 | 0 |
| Reacted & Formed | x | x |
| At equilibrium: | 1-X | X |

$K_C = [B]/[A]$, 4=x/1-x

4[1-x] = x, 5x=4 and x=4/5=0.8

**31. $PCl_5$ was taken at 2 atm in a closed vessel at $154^0$C. Keeping the temperature constant $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ equilibrium is established when 50% of $PCl_5$ decomposes. The $K_p$ for the equilibrium is**

1) 1atm 2)3atm 3)1.5atm 4)0.5atm

**Solution:** $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

| $PCl_5$ | $PCl_3$ | $Cl_2$ | |
|---|---|---|---|
| 1 mol | 0 mol | 0 mol | at start |
| 0.5 mol | 0.5 mol | 0.5mol | at equilibrium |

The pressure at equilibrium $= 2 \times \frac{1.5}{1} = 3$ atm

The partial pressures; $P_{PCl_5} = 3 \times \frac{0.5}{1.5} = 1$ atm , $P_{PCl_3} = 3 \times \frac{0.5}{1.5} = 1$ atm and $P_{Cl_2} = 3 \times \frac{0.5}{1.5} = 1$ atm

The equilibrium constant, $K_p = \frac{P_{PCl_3}\ P_{Cl_2}}{P_{PCl_5}} = \frac{1 \times 1}{1} = 1$ atm.

**32. The reaction was started with 0.1M each of CO and $H_2O$ at 800K. $K_c$ for the reaction $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$, at 800K is 4.24. What is the equilibrium concentration of the lightest gas?**

1)0.933M 2) 0.067M 3) 1.067M 4) 0.1M

**Solution:** $CO\ (g) + H_2O\ (g) \rightleftharpoons CO_2\ (g) + H_2\ (g)$

| | | | | |
|---|---|---|---|---|
| 0.1 | 0.1 | 0 | 0 | at start |
| 0.1 -x | 0.1 -x | x | x | at equilibrium |

The equilibrium constant $K_c$ is given as, $K_c = \frac{[CO_2][H_2]}{[CO][H_2O]} = \frac{x^2}{(0.1-x)^2} = 4.24$

$3.24x^2 - 0.848x + 0.0424 = 0$ , $3.059x = 0.2059$. Concentration of $H_2 = x =$ 0.067M.

**33. $K_p$ for the reaction, $NH_4HS_{(s)} \rightleftharpoons NH_3\ (g) + H_2S\ (g)$, at certain temperature is 4 $bar^2$. The equilibrium pressure of mixture is**

1)16bar 2)8bar 3) 2bar 4) 4bar

**Solution:** Equilibrium constant, $K_P = P_{NH3}$ X P of $H_2S$ .

Partial pressures are given as, $P_{NH3} = P_{H2S} = \sqrt{9} = 3$bar

Total pressure at equilibrium is obtained using Dalton's law of partial pressures as, $P_{NH3} + P_{H2S} = 3+3 = 6$bar.

**34. Calculate the ratio of pressures of $CO_2$ gas and CO gas at equilibrium in the reaction $CO_{2(g)} + C_{(s)} \rightleftharpoons 2CO_{(g)}$, if $K_p$ is 3 bar at 900K and initial pressure of $CO_2$ is 0.48 bar.**

1)1.2 2)0.75 3)0.557 4) 1.732

**Solution:** $CO_{2\,(g)} + C_{(s)} \rightleftharpoons 2CO_{(g)}$

0.48 bar 0 0 at start

0.48 -x 0 2x at equilibrium

$$K_p = \frac{P_{CO}{}^2}{pCO_2} = \frac{(2x)^2}{(0.48-x)} = 3 \Rightarrow \frac{2x}{0.48-x} = 1.732, \quad \frac{P_{CO_2}}{P_{CO}} = \frac{0.48-x}{2x} = \frac{1}{1.732} = 0.557$$

**35. For the cyclic trimerisation of acetylene to give one mole of benzene, $K_c$ = 64 $L^2mol^{-2}$. If the equilibrium concentration of benzene is 1.0 mol $L^{-1}$, The equilibrium concentration of acetylene is**

1)0.25M 2) 0.5M 3) 4M 4)0.05M

**Solution:** The equilibrium is, $3C_2H_{2\,g} \rightleftharpoons C_6H_{6(l)}$

$K_C=[C_6H_6]/[C_2H_2]^3$, $[C_2H_2]^3 =[C_6H_6]/K_C=1/64$

Equilibrium concentration of acetylene, $[C_2H_2]$ = 0.25 mol $L^{-1}$.

**36. At 1000K, $K_p = 1.0 \times 10^{-2}$ atm for the reaction,**

**$2NOCl_{(g)} \rightleftharpoons 2NO_{(g)} + Cl_{2(g)}$. The value of $K_c$ at the same temperature is**

1) $82.1 \times 10^{-2}$mol $L^{-1}$ 2 ) $82.1 + 10^{-2}$mol $L^{-1}$

3) $10^{-2}$ /82.1 mol $L^{-1}$ 4)82.1/ $10^{-2}$mol $L^{-1}$

**Solution:** Equilibrium constants are related as,

$K_c = K_p/(RT)^{\Delta n}$ $\Delta n$. = 2 + 1 – (2) = 1 and R = 0.0821 L-atm $K^{-1}$ $mol^{-1}$.

Equilibrium constant, $K_c = 1.0 \times 10^{-2} / (0.0821 \times 1000)$ mol $L^{-1}$.

**37. For the equilibrium, $2SO_{3\,(g)} \rightleftharpoons 2SO_{2\,(g)} + O_{2\,(g)}$, the partial pressures of**

**$SO_3$, $SO_2$ and $O_2$ gases, at 650K are respectively 0.3 bar, 0.6 bar and 0.4 bar. If the moles of both the oxides of sulphur are so adjusted as equal, the partial pressure of $O_2$ will be**

**1) 0.6bar 2) 1.6bar 3) 0.4bar 4)0.1bar**

**Solution:** The equilibrium given as, $2SO_3\,(g) \rightleftharpoons 2SO_2\,(g) + O_2\,(g)$,

Equilibrium constant, $K_p = \frac{p^2_{SO_2} p_{O_2}}{p^2_{SO_3}} = \frac{0.6 \times 0.6 \times 0.4}{0.3 \times 0.3} = 1.6\ \text{bar}$

on adjustment, $K_p$ does not change, 1.6bar= $x^2.P_{O2}/x^2$ . Partial pressure of oxygen = 1.6 bar.

**38. If 0.5 mol of CO, 0.2 mol of $Cl_2$ and 0.2 mol of $COCl_2$ are present at equilibrium in a 500ml of closed vessel at certain temperature. The $K_c$ for the reaction,**

$$CO\,(g) + Cl_{2(g)} \rightleftharpoons COCl_{2(g)} \text{ is}$$

1)1 mole $L^{-1}$ 2) 1 L $mol^{-1}$ **3)** 1 mole $L^{-1}$ **4)** 2 L $mol^{-1}$

**Solution:** [CO] =moles/v.in.L=0.5/0.5= 1 mol $L^{-1}$, $[Cl_2]$ = 0.2/0.5=0.4 mol $L^{-1}$ and $[COCl_2]$ = 0.2/0.5=0.4 mol $L^{-1}$.

Equilibrium constant, $K_C = [COCl_2]/[CO][Cl_2]$ = 1 L $mol^{-1}$.

**39. $K_c$ for the reaction $2X \rightleftharpoons Y+Z$ is $2 \times 10^{-3}$at a given time the composition of reaction mixture [X] = [Y] = [ Z] = $2.8 \times 10^{-4}$M. In what direction, the reaction will proceed?**

**1) Forward 2) Either forward or backward**

**3) Backward 4) Neither forward nor backward**

**Solution:** Reaction quotient Q is given as,

$$Q = \frac{[Y][Z]}{[X]^2},\quad Q = \frac{2.8 \times 10^{-4} \times 2.8 \times 10^{-4}}{(2.8 \times 10^{-4})^2} = 1$$

Since Q > K, the reaction proceeds in backward direction.

**40. What is the extent of dissociation if the equilibrium pressure p for the system $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ are numerically 3 times to its $K_p$.**

1) 0.5 2) 0.866 3) 0.25 4)1.0

**Solution:** $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

| | | | |
|---|---|---|---|
| 1 | 0 | 0 | at start |
| 1-x | x | x | at equilibrium |

Total moles at equilibrium (if x is extent of dissociation) = 1 – x + x + x = 1 + x

Partial pressure of $PCl_5$ , $P_{PCl_5} = \frac{1-x}{1+x}p$

Similarly, $\left(P_{PCl_3} = \frac{x}{1+x}p\right)$ and $P_{PCl_2} = \frac{x}{1+x}p$

Equilibrium constant,

$$K_p = \frac{P_{PCl_3}\,P_{Cl_2}}{P_{PCl_5}}$$

Substituting the values,

$$K_p = \frac{\left(\frac{xp}{1+x}\right)\left(\frac{xp}{1+x}\right)}{\frac{(1-x)p}{1+x}} = \frac{x^2p}{(1-x)^2}$$

, $\frac{p}{3} = \frac{x^2p}{1-x^2}$ $\rightarrow$X=0.5 i.e Extent of dissociation of $PCl_5$ = 0.5.

**Assertion and Reason Type Questions**

1) Both A & R are true, R is the correct explanation of A.

2) Both A & R are true, R is not correct explanation of A.

3) A is true, R is false.

4) Both A and R are true.

**41. A: Introduction of catalyst does not affect position of equilibrium.**

**R: For a reversible reaction, presence of a catalyst influences both forward &**

**backward reactions to same extent.**

**42. A: For $Zn_{(s)} + Cu^{+2}_{(aq)} \rightleftharpoons Zn^{+2}_{(aq)} + Cu_{(s)}$, $\Delta G = 0$, but $K_C = 10^{37}$**

**R: For a process under equilibrium Gibb energy change is zero, but as this process proceeds more towards right if $K_C > 1$.**

**43. A: For $N_2 + 3H_2 \rightleftharpoons 2NH_3$, $\Delta H = -Q$ KJ, low pressure yields more Ammonia.**

**R: According to Lechatlier's principle, increase of pressure shifts equilibrium in a direction that proceeds with increase in number of moles.**

**44. A: The degree of decomposition of $PCl_5$ is less at high pressures.**

**R: In a reversible reaction, on increasing the pressure the equilibrium shifts in the direction in which decrease in volume takes place.**

**45. A: $2SO_{2\,(g)} + O_{2\,(g)} \rightleftharpoons 2SO_{3\,(g)}$. In this equilibrium system, the yield of $SO_3$ is not altered in the presence of a catalyst.**

**R: A catalyst does not change the position of equilibrium.**

**46. A: The hydrolysis of an ester in acidic medium does not change with pressure.**

**R: Pressure does not show effect on equilibrium reactions taking place in solution.**

**47. If the degree of dissociation of $PCl_5$ in the reaction $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ at equilibrium is 0.2 and if the initial number of moles of $PCl_5$ is one, the total number of moles present in the gaseous mixture at equilibrium is**

1) 2.8 2) 1.2 3) 1.4 4) 1.6

**Solution:** $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

| | | | |
|---|---|---|---|
| 1 | 0 | 0 | at start |
| 0.2 | 0.2 | 0.2 | reactor formed at equilibrium |
| 0.8 | 0.2 | 0.2 | present at equilibrium |

The total moles at equilibrium=0.8+0.2+0.2=1.2

**48. The Kp value for $2SO_2$ (g) + $O_2$ (g) $\rightleftharpoons$ $2SO_3$ (g) is 5.0 atm$^{-1}$. What is the equilibrium pressure of $O_2$ if the equilibrium pressures of $SO_2$ and $SO_3$ are equal**

1) 0.2 atm 2) 0.3 atm 3) 0.4 atm 4) 0.1 atm

Solution: $K_P = 1/P_{O2}$ as the equilibrium pressures of $SO_2$ and $SO_3$ are equal. Thus $P_{O2} = 1/K_P = 1/5 = 0.2$

**49. One mole of ethyl alcohol and one mole of acetic acid are mixed. At equilibrium 0.666 moles of ester is present. The value of equilibrium constant is**

1) 1/2 2) 1/4 3) 2 4) 4

**Solution:** $CH_3COOH$ (l) +$C_2H_5OH$ (l) $\rightleftharpoons$ $CH_3COOC_2H_5$ (l) + $H_2O$ (l)

1.0 1.0 0 0 at start

1-0.666 1-0.666 0.666 0.666 at equilibrium

$K_C$ = (0.666x0.666)/(0.334x0.334)=4

**50. In the equilibrium $NH_4HS(s)$ $\rightleftharpoons$ $NH_3$ (g) + $H_2S$ (g) If the equilibrium pressure is 2 atm at $80^0$ C. $K_p$ for the reaction is**

1) 1atm 2) 2atm 3) 11atm$^2$ 4) 4 atm$^2$

Solution: $NH_4HS(s)$ $\rightleftharpoons$ $NH_3(g)$ + $H_2S(g)$ , P 0f $NH_3(g)$ + Pof $H_2S(g)$=2, P 0f $NH_3(g)$ = Pof $H_2S(g)$=1

$K_P$= P of $NH_3$ (g)X Pof $H_2S(g)$=1X1=1atm$^2$

**KEY**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1) 4 | 2) 3 | 3) 3 | 4) 2 | 5) 4 | 6) 4 | 7) 1 | 8) 1 | 9) 3 |
| 10) 4 | 11) 1 | 12) 1 | 13) 3 | 14) 2 | 15) 3 | 16)3 | 17) 4 | 18)1 |
| 19)2 | 20) 3 | 21) 2 | 22) 2 | 23) 3 | 24) 3 | 25) 2 | 26) 2 | 27)1 |
| 28)4 | 29)2 | 30) 3 | 31)1 | 32)2 | 33)4 | 34)3 | 35)1 | 36) 4 |
| 37) 2 | 38)2 | 39)3 | 40)1 | 41) 1 | 42) 1 | 43) 4 | 44) 1 | 45) 1 |
| 46) 1 | 47) 2 | 48) 1 | 49) 4 | 50) 3 | | | | |